Space Weather Technical Forecast

Issued on Thursday, 16 June 2022 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares throughout. Chance of G1 (Minor Storm) conditions days 1-3 (16th-18th). Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the last 24 hours, with occasional C-flares observed. Most notably a C3.4 from AR3036 (Dso/Beta) at 16/0440 UTC and a C3.3 from AR3030 (Dro/Beta) at 16/0725 UTC. There are currently 8 numbered sunspot regions on the visible disc and one unnumbered region, which rotated round the northeast limb during the period. The largest and most complex region presently on the disc is AR3031 in the southwest quadrant. This region is in a Beta-Gamma formation and appears to have a small delta spot in its trailing portion. However, the region didn't produce any significant flare activity over the past 24 hours. All other regions on the disc a relatively simple Alpha and Beta regions and haven't shown any significant signs of development during the period.
No Earth-directed CMEs were observed in the available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as observed by DSCOVR at L1, was initially slightly elevated, but increased from 15/0400UTC, with a peak of 624 km/s at 15/0556 UTC. It the subsequently settled at elevated levels between 550 and 600 km/s. Density was average or slightly above average but a short-lived period of above average occurred 15/0400-0500, with a peak of 29 ppcc. The Total Interplanetary magnetic field strength, Bt, was mostly weak (5-8 nT) but a period of Moderate (8-14 nT) occurred 15/0400 UTC to 15/0845 UTC. The north-south component, Bz, varied weakly but fluctuated more significantly (+/- 11 nT) during the period mentioned above. The phi angle was mostly positive (away from the Sun), although it fluctuated to negative at times, most likely between 15/1050 UTC and 15/1400 UTC. The above enhancements were most likely associated with the arrival of the 13th June CME. Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was very slightly above background levels, but with no solar radiation storms thresholds reached. Electron flux (greater than 2MeV) was at background to moderate levels. Corresponding 24-hour integrated electron fluence has been well below the Active (1e8 integrated pfu) threshold on a very slight rising trend. 3.95e6 integrated pfu was observed at 16/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mostly Low, with a chance of isolated Moderate flares, most likely from AR3031.

Solar Wind / Geomagnetic Activity: Solar winds are expected to be elevated through days 1-3 (16th) due to waning CME effects followed by coronal enhancements from CH90 and CH92. On day 4 (19th) winds are expected to decrease to slightly elevated levels as these features rotate from a geoeffective position.
Through days 1-3 (16th) geomagnetic activity is likely to be in the range Quiet to Active, with a

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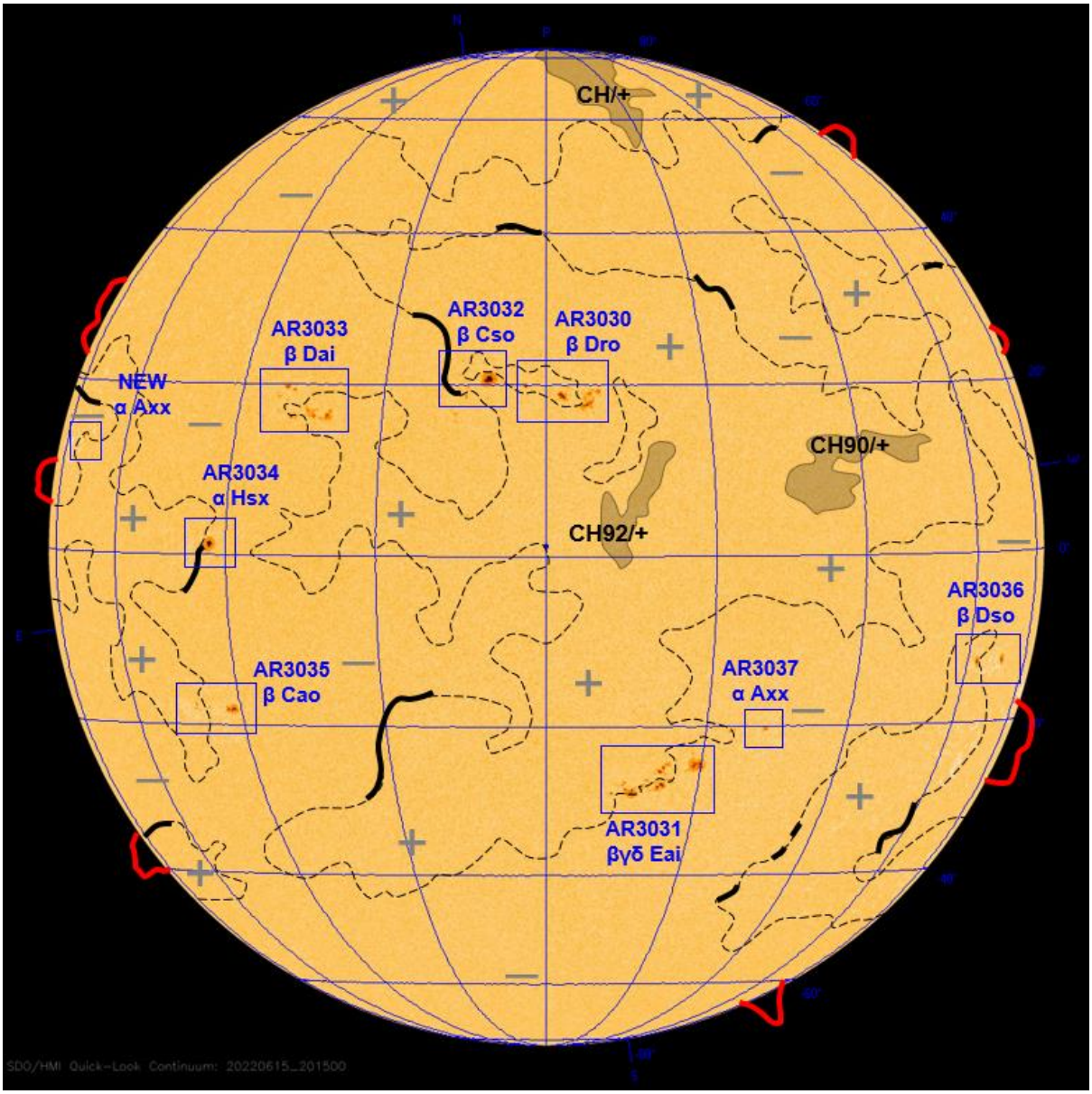
chance of an isolated G1/Minor Storm interval. This is most likely on day 1 (16th) and late day 2/early day 3 (17th/18th) during the arrival of CH90 and CH92 and their associated CIRs. On day 4 (19th), activity is expected to become Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at background, or just above background levels during the period, with only a very slight chance of an S1 or greater event occurring. High energy electron flux (greater than 2 MeV) is expected to start at mostly background levels with a chance of increasing to moderate or perhaps high levels later in the period, due to high speed stream influences. Electron fluence is expected to follow a gradual rising trend, with a chance of reaching Active (1e8 integrated pfu) levels by day 4 (19th).

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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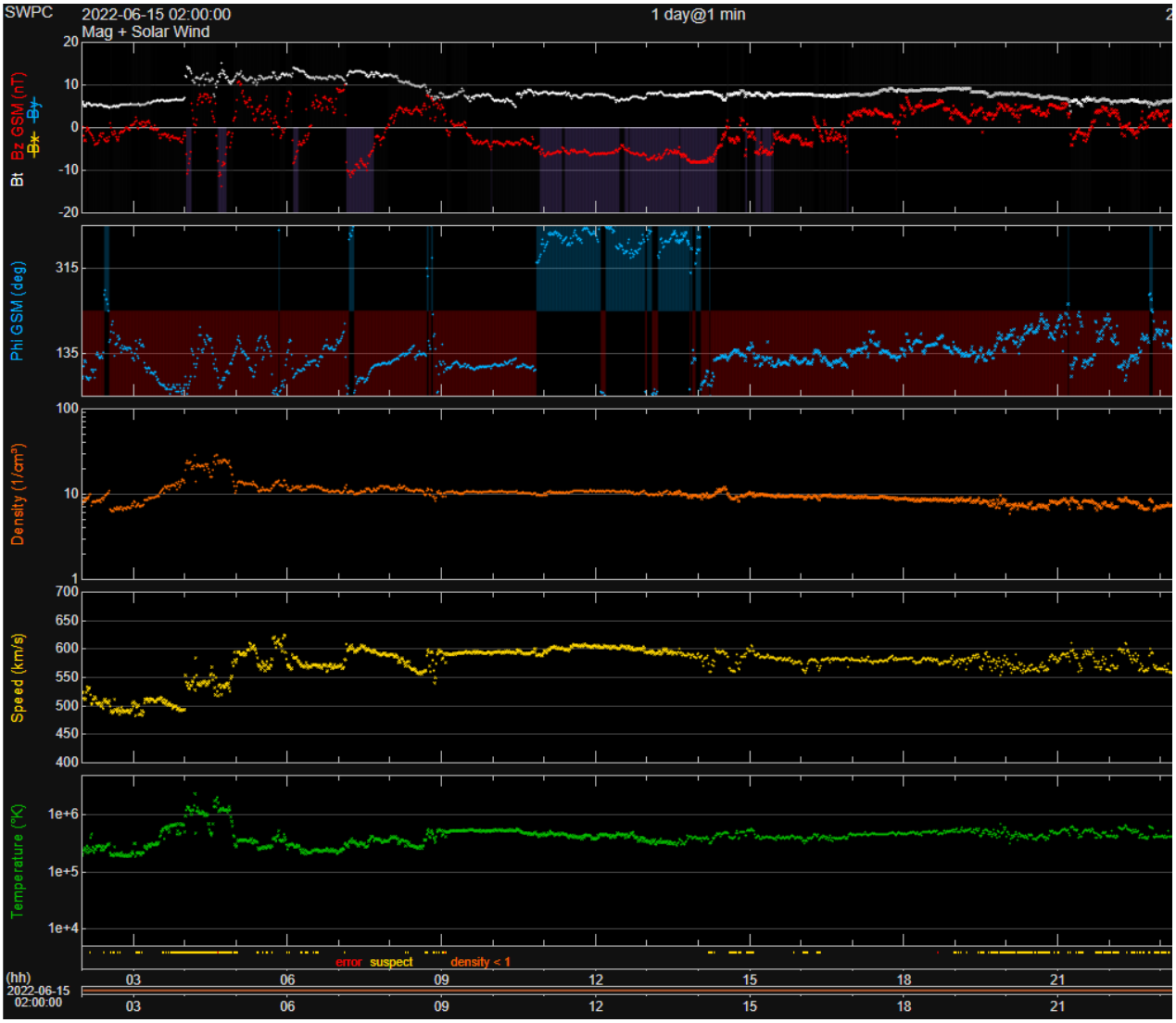
Figure 2: Solar wind parameters from DSCOVR at L1, as displayed by SWPC



Geomagnetic Storms:

A sudden impulse was observed at L1 at around 15/0400UTC, and is assessed as being the arrival of the anticipated glancing CME from 13th June. Solar winds briefly peaked around 620km/s, and have since levelled in the range 560-600km/s. No other CMEs are currently expected to affect Earth during the period.
Solar winds are expected to remain elevated through much of the forecast period. Initially from to the waning effects of the CME, and then due to the high speed streams from coronal holes 90 and 92, which are anticipated early on day 1 (16th) and late day 2/early day 3 (17th/18th) respectively. On day 4 (19th), solar winds should decline to slightly elevated levels as these features rotate away from a geoeffective position.
Through days 1-3 (16th) geomagnetic activity is likely to be in the range Quiet to Active, with a chance of an isolated G1/Minor Storm interval, most likely during the arrival of CH90 and CH92 and their associated CIRs. On day 4 (19th), activity is expected to become Quiet to Unsettled.

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Met Office Space Weather Technical Forecast

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

Radio Blackouts - X-Ray Flares:

There are currently 9 sunspot regions on the visible disc. The largest and most complex region is AR3031 in the southwest quadrant, which has a very small delta configuration in its trailing spot. All other regions are relatively simple Alpha and Beta regions and have remained broadly stable over the past 24 hours.

Solar activity is currently Low, with a few C-flares observed in the past 24-hour. Activity is expected to remain Low during the forecast period with further C-class flares. There is a chance (30%) of solar activity increasing to Moderate levels at times, with isolated M-class flares, and a very slight (5%) chance of X-class. The most likely source of any significant flaring is from AR3031.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) was close to background levels, although it has been very slightly elevated from long term background readings, following C-flare activity in recent days. The risk of a proton storm remains very low, but with a slight chance of an S1 or greater event due to the transit of AR3031 across the western solar hemisphere.

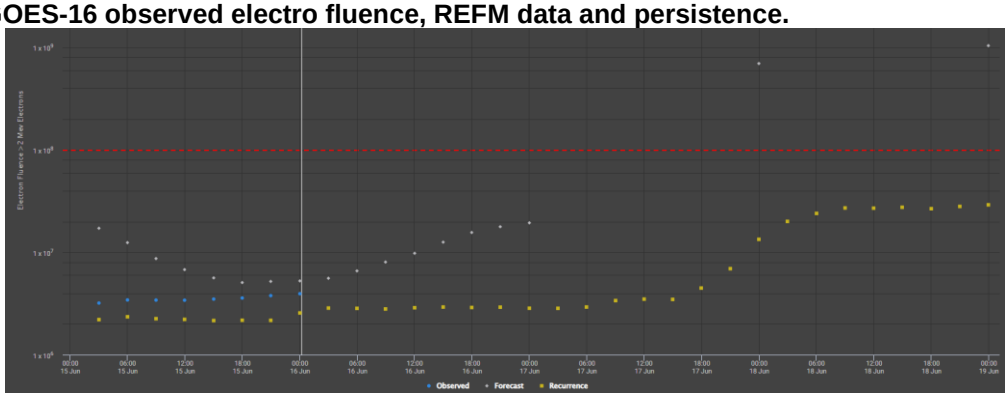
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at background to moderate levels. Similar conditions are likely to continue days 1-3 (16th-18th) with the electron belts suppressed due to the influence of a CME and two coronal hole high speed streams that follow. The risk of the electron flux becoming moderate or high increases as the high speed stream begins to weaken into day 4 (19th) allowing the Van Allen radiation belts to recharge themselves. The corresponding electron fluence is therefore also expected to rise later in the period, but it is currently thought that it will remain below the Active (1e8 integrated pfu) threshold at this stage, with the REFM output considered to be a little high with this increase and values closer to recurrence more likely.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	20	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: GOES-16 observed electro fluence, REFM data and persistence.



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